POWER ASSISTED DRILL PRESS

This application claims priority of U.S. Provisional Patent Application #60/412,701, filed 9/23/2002.

BACKGROUND OF THE INVENTION

The present invention relates in general to drill press devices, and more particularly, to a novel drill press apparatus having a controlled power assisting feed mechanism and a vacuum holding system.

In a conventional drill press, a rack and pinion gear is typically used to linearly move the rotating drill chuck toward the work material. The rack and pinion system applies the force to the drill bit through said chuck. Said drill bit utilizes said force to bore through the work material. Unfortunately, a conventional drill press is often heavy, not portable, and unable to drill a hole onto a surface unless the work material is between the drill and drill press table or base. Even the commercially available drill press stands which utilize conventional hand held drill motors, exhibit the aforesaid undesirable features. Moreover, those commercially available drill presses which are reasonably portable rely upon a magnetic base or clamps for attachment, mounting, and holding. This unfortunately limits use to magnetically attachable materials such as steel or iron or tends to mark or deform the mounting surface respectfully.

The present art overcomes the prior art limitations by providing a drill motor and chuck combination which is mounted with a motor frame and linearly actuated via the force of a feed cylinder. Preferably, the feed cylinder is a pneumatically actuated cylinder but may also be hydraulic, electromagnetic, or a mechanical force actuator in alternative embodiments. Also, the drill motor is preferably a commercially available pneumatically operated hand held drill with attached chuck but may also be electrically or hydraulically actuated, whether commercially available or custom built for the present art. The linearly moveable motor frame is movably mounted onto or with a press frame. The present art further provides for quick and easy securing and removal of the press onto a surface via the action of a suction cup. The suction cup attachment method allows for non-deforming attachment and mounting to surfaces which are either magnetic or non-magnetic.

An alternative embodiment of the present invention places the feed cylinder at a base plate

instead of a top plate. This alternative embodiment allows the feed cylinder to apply force to and move the work material toward the drill bit instead of the drill bit moving toward the work material. This alternative embodiment preferably secures the drill motor to the top plate of said press frame which also functions as a motor frame. Further alternative embodiments may utilize both a feed cylinder on the top plate and a feed cylinder on the base plate. In this configuration, typically the shaft of the air cylinder mounted on the base plate contains a shaft tip having a recess for drill bit clearance when the bit bores through the work material. Alternative embodiments may forego use of the shaft tip without departing from the scope of the present art.

The preferred embodiment of the present invention provides a lightweight and portable power assisted drill press apparatus which only requires compressed air for operation. A further embodiment of the present invention provides a unique suction cup base which allows for mounting on any surface capable of holding the vacuum of said suction cup. This alternative mounting method allows for power assisted drilling on surfaces which otherwise would require drilling by hand.

Accordingly, it is an object of the present invention to provide an improved power assisted drill press which in a preferred embodiment is capable of full operation from a pneumatic supply.

Another object of the present invention is to provide an improved power assisted drill press which is portable and capable of controllably feeding the drill or work material via a user's actuation.

A further object of the present invention is to provide an improved power assisted drill press having a suction cup base which is capable of attaching to any surface which can maintain the suction cup vacuum, even if the surface is not planar or flat.

A still further object of the present invention is to provide an improved power assisted drill press which allows a person to operate the apparatus with a single hand when required.

SUMMARY OF THE INVENTION

To accomplish the foregoing and other objects of this invention there is provided an improved power assisted drill press apparatus for use in applications where a drill press is desired or required. In a preferred embodiment, the apparatus comprises a drill motor and chuck combination which is mounted with a motor frame and linearly actuated via the force of a feed cylinder. Alternative

embodiments utilize a suction cup which provides for quick and easy securing and removal of the press onto a surface via the suction action of said cup. Further alternative embodiments place the feed cylinder at a base of the apparatus, thereby applying force to the work material and moving said material toward the drill bit instead of the drill bit moving toward the work material.

Preferably, the feed cylinder is a pneumatically actuated cylinder but may also be hydraulic, electromagnetic, or a mechanical force actuator. Also, the drill motor is preferably a commercially available pneumatically operated hand held drill with attached chuck but may also be electrically or hydraulically actuated, whether commercially available or custom built for the present art. The linearly moveable motor frame is movably mounted onto or with a press frame.

In a preferred embodiment, the motor frame first comprises a motor plate having a hole through which said drill motor is placed and held, preferably with a set screw. In a preferred embodiment, the drill motor chuck and drill bit extends through the motor plate. Attached with said motor plate is the first end(s) of one or more guide rods. Said guide rods preferably attach opposite of said drill motor chuck and drill bit extension. A second end(s) of said guide rod(s) aligns with and moveably mates through one or more guide holes in a top plate of the press frame. The top plate of said press frame is mounted onto, near, or toward a first end of a frame support or shaft which extends and mounts with a frame base.

In the preferred embodiment, one or more springs are placed onto said guide rods between said second end(s) and said top plate of the press frame. Near said second end(s) is preferably placed one or more keepers to maintain said springs in position and compression on said rods, between said top plate and said keepers. Said springs serve to supply retraction force to the motor frame when the feed cylinder is not actuated.

Also mounted onto said top plate of said press frame is the feed cylinder. Preferably said feed cylinder mounts between said second ends of said guide rods. In the preferred embodiment, the feed cylinder supplies a force onto said drill motor or motor frame and thereby causes the combination, including the guide rods, to move toward the work material. In the preferred embodiment, the feed cylinder is pneumatically controlled with an air pressure regulator. That is, the air pressure regulator controls and regulates the air pressure in the cylinder via the user's desired input, thereby controlling the force which is placed onto the work material through the drill bit.

Preferably, the air pressure regulator is mounted with or near said motor frame whereby the hand of the user stays near and follows the drill motor actuation switch and pressure regulator as the drill bit approaches the work material. A unique feature claimed in an embodiment of the present invention and in furtherance of the foregoing is the ability of the user to utilize the index finger to control the speed of the drill motor and the thumb of the same hand to control the force on and movement of the drill bit.

One of the embodiments of the present invention utilizes a suction cup mounted with a second end of said frame support. The suction cup allows the drill press to be mounted onto and drill into a surface. This feature is especially useful when the work material cannot fit between the drill bit and base plate. The feature, unlike magnetic base drill presses, allows attachment to a surface even if the surface has a low magnetic permeability such as aluminum, low iron content metals, and non metals such as plastics and woods. Said suction cup is preferably evacuated and held in place via the vacuum of a venturi attached with said suction cup. In the preferred embodiment, a pneumatic switch or valve is located on or near the motor frame or motor plate and allows the user to easily supply compressed air to the venturi which supplies vacuum to the suction cup.

An alternative embodiment of the present invention places the feed cylinder at the base plate instead of the top plate. This alternative embodiment allows the feed cylinder to apply force to and move the work material toward the drill bit instead of the drill bit moving toward the work material. This alternative embodiment preferably secures the drill motor to the top plate of said press frame which also functions as the motor frame.

For all of the aforesaid pneumatic devices, i.e. motor, switch, regulator, venturi, or other device, a pneumatic source is presumed available and able to feed each of the aforesaid components. The aforesaid press and motor frames and associated components may be manufactured from a variety of materials including but not limited to metals and alloys thereof, plastics, and composites. In a preferred embodiment, the frame and associated components are manufactured from an aluminum alloy and the guide rods and frame support are manufactured from steel.

BRIEF DESCRIPTION OF THE DRAWINGS

Numerous other objects, features and advantages of the invention should now become

apparent upon a reading of the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 shows a perspective view of the power assisted drill press without the air feed lines and the suction cup.

FIG. 2 shows a left side plan view of the power assisted drill press with the air feed lines and the suction cup. The base plate is rotated into a position substantially near or in the same axis as the drill bit.

FIG. 3 shows a perspective view of the power assisted drill press with the suction cup and base plate support and without the air feed lines. The base plate is rotated to serve as a stabilizing moment arm relative to the drill bit force when the suction cup is utilized.

FIG. 4 shows a perspective view of the power assisted drill press with the suction cup and base plate support and without the air feed lines. The base plate is rotated into a position substantially near or in the same axis as the drill bit.

FIG. 5 shows a side plan view of an alternative embodiment of the power assisted drill press with the air feed lines. This alternative embodiment has the air feed cylinder located with the base plate.

FIG. 6 shows a pneumatic schematic diagram of the air supply to the drill motor and valve, feed cylinder and regulator, and suction cup, venturi, and valve.

FIG. 7 shows a bottom plan view of the suction cup and mating plate of the present invention.

FIG. 8 shows a cross sectional view of the suction cup and mating plate of the present invention taken along line 7-7 in Figure 7.

DETAILED DESCRIPTION

Referring now to the drawings, the improved power assisted drill press apparatus **10** is shown in its preferred and alternative embodiments. The apparatus **10** is especially useful in applications where a portable and self feeding drill press is desired or required and when said drill press requires non-destructive mounting on a non-magnetic surface.

The present art overcomes the prior art limitations by providing a drill motor **18** and chuck **22** combination which is mounted with a motor frame **12** and linearly actuated via the force of a feed

cylinder **40**. Preferably, the feed cylinder **40** is a pneumatically actuated cylinder but may also be hydraulic, electromagnetic, or a mechanical force actuator. Also, the drill motor **18** is preferably a commercially available pneumatically operated hand held drill with attached chuck **22** but may also be electrically or hydraulically actuated, whether commercially available or custom built for the present art. The linearly moveable motor frame **12** is movably mounted onto or with a press frame **51**. The present art further provides for quick and easy securing and removal of the press **10** onto a surface via the action of a suction cup **68**. A drill bit or equivalent element, including but not limited to countersink bits, reamer bits, taps, or deburring tool bits, are typically mounted within said chuck **22** to perform the desired drilling operation, but alternative embodiments may forgo use of the chuck **22** and utilize other means to attach the drill bit or equivalent element to the drill motor **18**. In the preferred embodiment, said bit is opposite yet substantially pointing toward a plane of a second end **61** of a frame support **58** of said press frame **51**.

In a preferred embodiment, the motor frame **12** first comprises a motor plate **14** having a hole **16** through which said drill motor **18** is placed and held, preferably with a set screw **24**. In a preferred embodiment, the drill motor **18**, chuck **22**, and drill bit extends through the motor plate **14**. Attached with said motor plate **14** is the first end(s) **28** of one or more guide rods **26**. In the preferred embodiment, two guide rods **26** are utilized. Said guide rods **26** preferably attach opposite of said drill motor **18**, chuck **22** and drill bit extension. Alternative embodiments may place or locate said guide rods **26** at various locations on or with said motor plate **14** without departing from the scope and spirit of the present invention. A second end(s) **30** of said guide rod(s) **26** aligns with and moveably mates through one or more guide holes **38** in a top plate **36** of the press frame **51**. Alternative embodiments may attach the drill motor **18** and chuck **22** combination in a plurality of ways including but not limited to clamps, welds, or bolts.

In the preferred embodiment, one or more springs **34** are placed onto said guide rods **26** between said second end(s) **30** and said top plate **36** of the press frame **51**. Near said second end(s) **30** is preferably placed one or more keepers **32** to maintain or contain said springs **34** in position and compression on said rods **26**, between said top plate **36** and said keepers **32**. Said springs **34** serve to supply retraction force to the motor frame **12** when the feed cylinder **40** is not actuated. Alternative embodiments may utilize springs in tension between said top plate **36** and said motor plate

14, supply retraction force with an air cylinder, or forego use of said springs **34** completely.

Also mounted onto said top plate **36** of said press frame **51** is the feed cylinder **40**. Said top plate **36** having a through hole **48** for the moving shaft **44** of said cylinder **40** to contact and linearly move the drill motor **18** or motor frame **12**. Preferably said feed cylinder **40** mounts between said second ends **30** of said guide rods **26**. The feed cylinder **40** also is preferably mounted with threads into said through hole **48** of said top plate **36**. Alternative embodiments may utilize any location or method of attachment of said feed cylinder **40** onto said top plate **36** without departing from the scope and spirit of the present invention.

In the preferred embodiment, the feed cylinder **40** supplies a force onto said drill motor **18** or motor frame **12** and thereby causes the combination, including the guide rods **26**, to move toward the work material. In the preferred embodiment, the feed cylinder **40** is pneumatically controlled with a pneumatic or air pressure regulator **64**. That is, the air pressure regulator **64** controls and regulates the value of the air pressure in the cylinder **40** via the user's desired input, thereby controlling the force which is placed onto the work material through the drill bit. That is, the air pressure regulator **64** has an activating lever **67** or switch which may be pushed to control the pneumatic pressure supplied by the regulator. As the lever **67** or switch is pushed or displaced, the pneumatic or air pressure supplied from the output port **66** increases relative to the aforesaid displacement. In the preferred embodiment, the output port **66** of the air pressure regulator **64** pneumatically feeds a pneumatic input port **42** of the feed cylinder **40** thereby creating a linear force onto said shaft **44** relative to the displacement of said lever **67**. When the air pressure regulator **64** is released, the pressurized output port **66** is vented to atmosphere, thereby venting the feed cylinder **40** and allowing the motor frame **12** to retract via the action of said springs **34**. In the preferred embodiment, the pressure regulator **64** is an MAR-1CP manufactured by Clippard. Alternative embodiments may utilize other brands or models of pressure regulators for cylinder movement.

Preferably, the air pressure regulator **64** is mounted with or near said motor frame **12** whereby the hand of the user stays near and follows the drill motor actuation switch **20** and pressure regulator **64** as the drill bit approaches the work material. A unique feature claimed in an embodiment of the present invention and in furtherance of the foregoing is the ability of the user to utilize the index finger to control the speed of the drill motor **18** via the actuation switch **20** and the thumb of the same

hand to displace the lever **67** of the regulator **64** to control the force on and movement of the drill bit.

The top plate **36** of said press frame **51** is mounted onto or near a first end **59** of a frame support **58** or shaft which extends and mounts with a frame base **52**, thereby forming a gap between said frame base **52** and the bit. The preferred embodiment utilizes a cylindrical shaft **58** on which the frame base **52** may pivot or rotate. That is, the frame base **52** preferably has a through hole **60** of substantially the same size as the frame support shaft **58**, thereby allowing the base **52** to pivotably fit over the support shaft **58**. The frame base **52** preferably has one or more set screws **62** impinging onto the support shaft **58** to slidably hold said base **52** onto and at a desired position with said support shaft **58**. Alternative embodiments may utilize other methods or means of mechanically fastening said frame base **52** onto said support shaft **58** without departing from the scope and spirit of the present invention. These include but are not limited to welds, threads, screws and bolts, frictional fits, and/or integral molding or casting.

In the preferred embodiment, said frame base **52** comprises a base plate **54** having the aforesaid support shaft hole **60**. Alternative embodiments may utilize a frame base **52** having a plurality of shapes or sizes. Unique to the base plate **54** of the present invention is the extension of a base plate support **56**, preferably a bolt or screw, from the base plate opposite the side closest to the drill bit. This feature is especially useful in conjunction with the suction cup **68** attachment embodiment. When utilized apart from the suction cup **68** attachment embodiment, the base plate **54** is typically rotated and secured under the drill bit. This allows the work material to be placed between the drill bit and base plate **54** during the drilling operation.

One of the embodiments of the present invention utilizes a suction cup **68** mounted with a second end **61** of said support shaft **58**. The suction cup **68** allows the drill press **10** to be mounted onto and drill into a surface. This feature is especially useful when the work material cannot fit between the drill bit and base plate **54**. This feature, unlike magnetic base drill presses, allows attachment to a surface even if the surface has a low magnetic permeability such as aluminum, low iron content metals, and non metals such as plastics and woods.

Said suction cup **68** is preferably evacuated and held in place via the vacuum of a venturi **74** attached with said suction cup **68**. The suction cup **68** is commercially available from Schalmz GmbH, yet is modified for the present art. Other commercial manufacturers such as Anver and others

provide equivalent suction cups which may be utilized with the present art. Within the cup cavity **70** is placed a mating plate **72** with a mating surface **73** which substantially conforms to the surface of the work material. In the preferred embodiment, the plate **72** is attached within said cup cavity **70** yet the mating surface **73** is positioned such that it does not extend beyond the surface represented by the large circumference of the suction cup **68**. When the suction cup **68** is placed onto the work surface and the venturi **74** evacuates or draws a suction on said cup **68**, the mating surface **73** of the mating plate **72** contacts the work surface thereby stabilizing the press frame **51**. Alternative embodiments may forego utilization of the mating plate **72**. The base plate **54** with its base plate support **56** is typically pivoted or rotated opposite or away from the location of drill bit contact with the work material and secured to the frame support shaft **58**. The base plate support **56** is extended from the base plate **54** to contact the work surface and help stabilize the press frame **51** during the drilling operation. That is, the base plate **54** serves as a moment arm to provide a counteracting force relative to the drill bit force in order to maintain proper orientation of the press frame **51**. Said base plate support **56** is preferably a threaded bolt or screw but may also comprise any mechanical support device which is capable of contacting the work surface and help stabilize the press frame **51**.

In the preferred embodiment, a pneumatic switch **76** or valve is located on or near the motor frame **12** or motor plate **14** and allows the user to easily supply compressed air to the venturi **74** which supplies vacuum to the suction cup **68**. Since this switch **76** is located near the user's hand, the user may easily turn on the pneumatic switch **76** prior to a drilling operation in order to secure the device via venturi **74** vacuum to the work surface. When the switch **76** is positioned in an off position, compressed air is no longer supplied to the venturi **74** and the venturi **74** allows the suction cup **68** to vent to atmosphere. In the preferred embodiment the venturi **74** comprises a Fastvac #VP00-60H manufactured by Vaccon but other manufacturers also commercially manufacture an equivalent venturi. In the preferred embodiment, the venturi **74** is mounted upon the base plate but may be mounted at any location which is desired, provided the suction cup **68** receives the required vacuum.

An alternative embodiment of the present invention places the feed cylinder **40** at the base plate **54** instead of the top plate **36**. This alternative embodiment allows the feed cylinder **40** to apply force to and move the work material toward the drill bit or drill motor **18** instead of the drill bit

moving toward the work material. This alternative embodiment preferably secures the drill motor **18** to the top plate **36** of said press frame **51** which also functions as the motor frame **12**. Further alternative embodiments may utilize both a feed cylinder **40** on the top plate **36** and a feed cylinder **40** on the base plate **54**. In this configuration, typically the shaft **44** of the feed cylinder **40** mounted on the base plate **54** contains a shaft tip **46** having a recess for drill bit clearance when the bit bores through the work material. Alternative embodiments may forego use of the shaft tip **46** without departing from the scope of the present art.

In operation, the user first connects an pneumatic compressed air supply to the power assisted drill press **10** of the present art. If the user desires to drill a work material which will fit between the base plate **54** of the frame base **52** and the drill bit, the user rotates and secures the base plate **54** in a position substantially near or in the same axis as the drill bit. The user then places the work material between said base plate **54** and the drill bit and activates or presses on the air pressure regulator **64** activating switch or lever **67** to begin application of a user variable pressure to the feed cylinder **40**. As the drill bit is moved near or onto the work material due to the movement of the feed cylinder **40**, the user activates the drill motor **18** via a valve or switch **20** which energizes the drill and rotates the drill bit. As the drill bit contacts the work material, the user may further press the air pressure variable regulator **64** activating switch or lever **67** to supply a higher pressure to the feed cylinder **40** and thereby increase the force on the drill bit. As the force on the drill bit increases, generally the speed of cutting increases. After the user completes the drilling procedure, the user may release the air pressure regulator **64** activating switch or lever **67** to vent the feed cylinder **40** to atmosphere, thereby allowing retraction of the drill bit from the work material. The suction cup **68** may be utilized to stabilize or secure the press onto a surface during the drilling process.

The alternative embodiment having the feed cylinder **40** located with the base plate **54**, functions much as aforesaid. That is, the user places work material between the drill bit and the feed cylinder **40** shaft tip **46** and performs the same aforesaid operation. Instead of the drill bit moving relative to the press frame **51**, the press frame **51** moves relative to the work material via the action of the feed cylinder **40**.

If the user should desire to drill a hole in a surface work material which cannot be placed between the base plate **54** and the drill bit, the user then utilizes the aforesaid suction cup **68** to secure

the press frame **51**. That is, the user preferably first rotates the base plate **54** to a position substantially opposite the drill bit in order to serve as a stabilizing moment arm relative to the drill bit force. The base plate **54** is then secured via the set screw **62** impinging upon the frame support shaft **58**. The user then turns on the valve **76** which supplies compressed air to the venturi **74** which then evacuates the suction cup **68** and draws the press frame **51** onto the surface with the mating plate **72** within the cup cavity **70** contacting the surface of the work material. The user may then adjust the base plate support **56** to contact the work material surface and allow the base plate **54** to provide the necessary counteracting moment arm relative to the drill bit. The user then repeats the aforesaid steps of activating the regulator **64** via the lever **67** and drill motor **18** via the actuation switch **20** to move the drill bit into contact with the work surface and drill the desired hole. Alternative embodiments may perform the aforesaid functions without utilization of the mating plate **72** or base plate **54**.

From the foregoing description, those skilled in the art will appreciate that all objects of the present invention are realized. A power assisted drill press apparatus for drilling in non-conventional applications where a drill press is desired or required is shown and described. The drill press of the present art is especially suited to applications where portability is desired and with its suction cup mounting is especially useful for mounting upon surfaces which are non-magnetic.

Having described the invention in detail, those skilled in the art will appreciate that modifications may be made to the invention without departing from its spirit. Therefore, it is not intended that the scope of the invention be limited to the specific embodiments illustrated and described. Rather it is intended that the scope of this invention be determined by the appended claims and their equivalents.